Utilizing orbital atherectomy for stent ablation following unsuccessful S-IVL of an underexpanded stent

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A 67-year-old man with hypertension, hyperlipidemia, diabetes, and multivessel coronary artery disease, who had undergone multiple percutaneous coronary interventions, presented to the hospital with a non-ST-segment elevation myocardial infarction.

Angiography revealed significant focal in-stent restenosis in the proximal left anterior descending artery with a partially underexpanded stent modeled on a calcified nodule (Figure 1A). Initially (16 months earlier), the lesion was treated with Shockwave Intravascular Lithotripsy (S-IVL) (3.5 × 12 mm — 80 pulses) followed by drug-eluting stent (DES) implantation and intravascular ultrasound guidance in the course of non-ST-segment elevation myocardial infarction. The post-procedural minimal stent area (MSA) was 6.1 mm^2. Eight months earlier, the corresponding segment of the left anterior descending artery had undergone high-pressure (22 atm) noncompliant balloon (NCB) 3.5 × 15 mm inflation followed by drug-eluting balloon 3.5 × 15mm (15 atm) inflation due to focal in-stent restenosis (post-procedural intravascular ultrasound — MSA — 6.6 mm^2) in the setting of symptomatic Canadian Cardiovascular Society class II angina pectoris.

To address the issue of recurrent restenosis and the ineffectiveness of previous therapies, we optimized stent expansion by using a second S-IVL (4.0 × 12 mm —120 pulses) (Figure 1B). Notably, control optical coherence tomography (OCT) demonstrated no significant increase in MSA (4.53 mm^2) (Figure 1A). Therefore, after consultation with our internal interventional team, we decided to use an orbital atherectomy (OA) device to perform *ad-hoc* deep punctate atheroablation of the calcified nodule and the previously implanted DES (Figure 1C).

Two low-speed (80 000 rpm) and 28 high-speed (120 000 rpm) OA runs were performed. Control OCT demonstrated complete ablation of the DES and a significant reduction in calcium protrusion (Figure 1C). Subsequently, a new DES (3.5 × 16 mm) was reimplanted (Figure 1D) with additional postdilatation with 4.0 × 12 mm (20 atm) NCB. Control OCT confirmed adequate stent expansion with a significant MSA increase (10.2 mm^2) (Figure 1D).

Stent underexpansion remains a challenge for percutaneous coronary interventions. High-pressure NCB inflation is the first-line treatment but often fails and may increase the risk of perforation [1]. Recently, S-IVL demonstrated efficacy in facilitating stent expansion [2, 3]. Here, the S-IVL device was used twice, once to prepare the lesion and once to optimize the underexpanded stent, resulting in a suboptimal outcome. We chose to use OA off-label due to the potential interaction with the deep calcium identified on OCT. Substantial eccentric protrusion of a large amount of calcified plaque directly into the lumen led us to OA.

Atherectomy is an effective technique for lesion preparation, but its ability to counteract stent underexpansion is uncertain and limited to rotational devices [4]. The OA manufacturer strongly discourages stent ablation due to safety concerns regarding the risk of stent

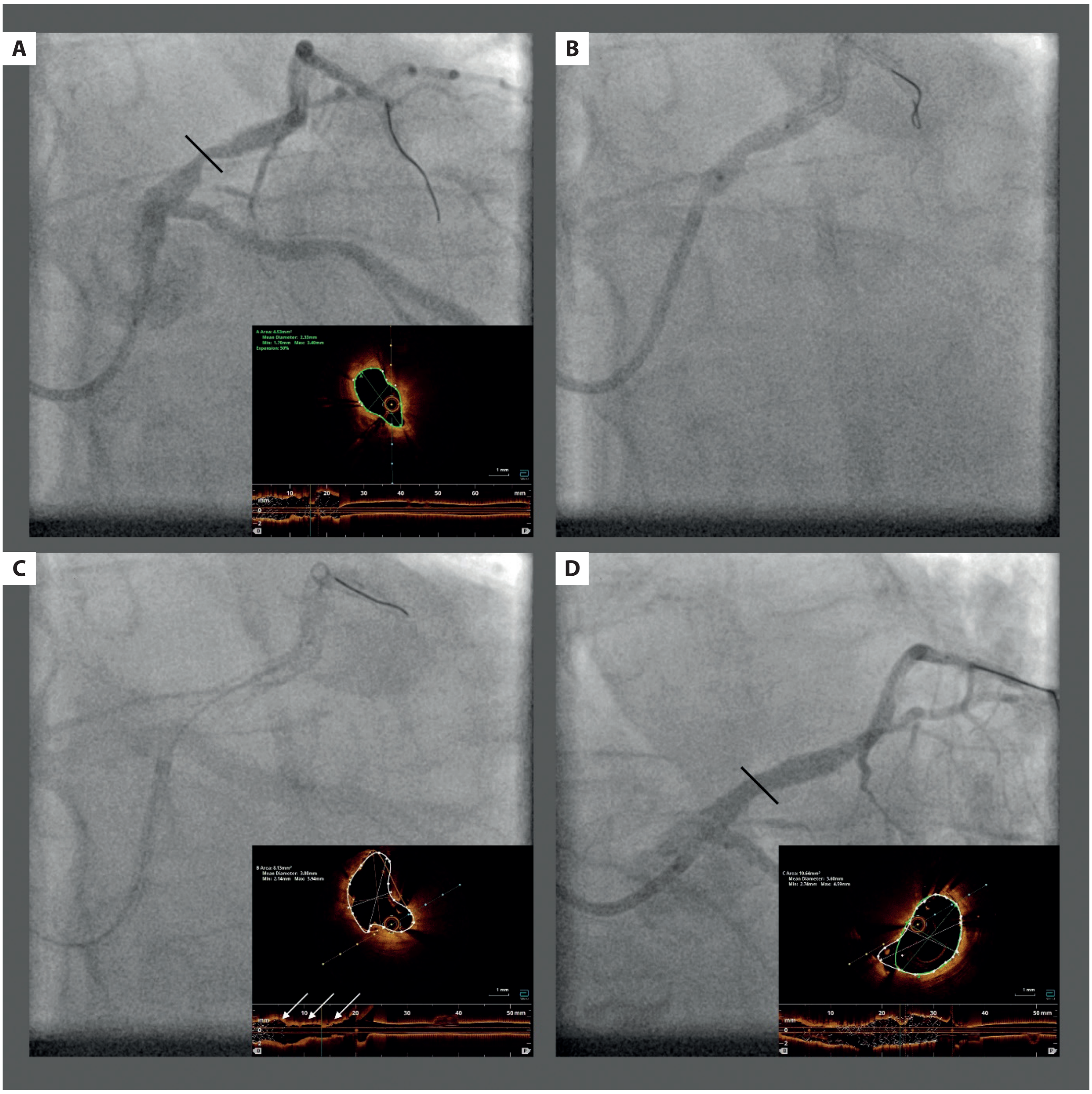

Figure 1. Stent ablation with orbital atherectomy (OA) after unsuccessful Shockwave Intravascular Lithotripsy (S-IVL) of an underexpanded stent. **A.** Initial coronary angiography and initial optical coherence tomography (OCT) view. **B.** S-IVL 4.0 × 12 mm of underexpanded stent. **C.** OA of the underexpanded stent and post-OA OCT; white arrows show complete stent ablation. **D.** Final coronary angiography and final OCT

entanglement or crown entrapment related to the orbital nature of this device [5]. In addition, ablation debris may cause coronary microvascular obstruction resulting in periprocedural slow/no-flow phenomena. Furthermore, the risk of vessel perforation appears to be significantly increased during stent ablation.

However, we demonstrated that multiple high-speed OA can significantly interact with the vessel interior, resulting in complete stent ablation and a significant reduction in calcium protrusion.

Article information

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REFERENCES

1. Giustino G, Colombo A, Camaj A, et al. Coronary in-stent restenosis: JACC State-of-the-Art Review. J Am Coll Cardiol. 2022; 80(4): 348–372, doi: 10.1016/j.jacc.2022.05.017, indexed in Pubmed: 35863852.
2. Rola P, Furtan Ł, Włodarczak S, et al. Safety and efficacy of a novel calcified plaque modification technique — Shockwave Intravascular Lithotripsy — in patients with coronary artery disease: Mid-term outcomes. Kardiol Pol. 2023; 81(9): 878–885, doi: 10.33963/KP.a2023.0152, indexed in Pubmed: 37448216.
3. Wańha W, Tomaniak M, Wańczura P, et al. Intravascular lithotripsy for the treatment of stent underexpansion: The multicenter IVL-DRAGON registry. J Clin Med. 2022; 11(7): 1779, doi: 10.3390/jcm11071779, indexed in Pubmed: 35407387.
4. Whiteside HL, Nagabandi A, Kapoor D. Stentablation with rotational atherectomy for the management of underexpanded and undilatable coronary stents. Cardiovasc Revasc Med. 2019; 20(12): 1203–1208, doi: 10.1016/j.carrev.2019.02.025, indexed in Pubmed: 30842041.
5. Rola P, Furtan Ł, Włodarczak S, et al. Orbital atherectomy for treatment of calcified coronary artery lesions. First experiences in Poland: Short-term outcomes of the Lower-Silesia Orbital Atherectomy Registry (LOAR). Kardiol Pol. 2023; 81(2): 174–176, doi: 10.33963/KP.a2023.0003, indexed in Pubmed: 36594531.